

Triple3 Redundant Spacecraft Subsystems (T3RSS), Phase I

Completed Technology Project (2006 - 2007)



Project Introduction

Redefine Technologies, along with researchers at the University of Colorado, will use three redundancy methods to decrease the susceptibility of a spacecraft, on a mission survivability level, to electronic failures anywhere throughout the spacecraft. By using Field Programmable Gate Array (FPGA) chips, we will analyze the spacecraft-wide benefits of: *triplicating the logic and RAM on-board each subsystem using a Xilinx proprietary Triple Modular Redundancy (TMR) tool; *triplicating the persistent memory storage (i.e. ROM, science data, and flight code) on-board each subsystem using various methods specific for the space environment; and, *triplicating the backup architecture itself, while reducing weight and volume requirements, so subsystem code can run on alternate processors if any component is rendered inoperable due to an electronic failure (radiation, manufacturing, human-error, etc). These three methods of triplication should significantly increase the reliability of non-radiation hardened designs, which should allow commercial off-the-shelf (COTS) processing components to be used as flight critical hardware. The analysis that is performed will predict the total benefit of this approach to any future spacecraft.

Anticipated Benefits

Potential NASA Commercial Applications: Redefine Technologies will closely investigate the patentability of all claims related to this research. The code distribution methods under consideration are marketable, either as an off-the-shelf product that can be sold to spacecraft system manufacturers or as services provided by Redefine Technologies in its normal consulting business. As mentioned earlier, the Spacecraft Benchmark Software Code (SBSC) will be made available on the Redefine Technologies' website for all to use and compare designs against. This standalone product of the Phase I research will follow the same business philosophy as personal computer benchmark tests or products under the GNU Public License. This code set will be improved upon over time and used industry-wide as a standardized test platform. It will solidify the redundancy technology proposed here, create healthy competition that will result in better and better products, and it will further standardize spacecraft design.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

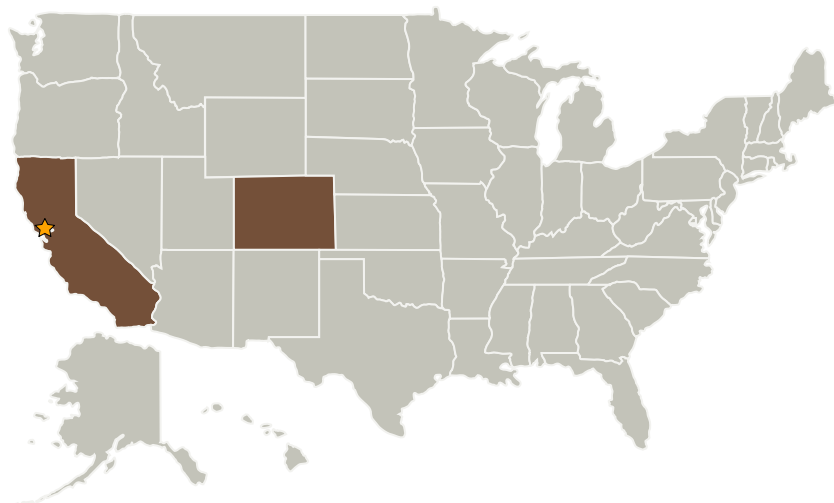
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Ames Research Center (ARC)	Lead Organization	NASA Center	Moffett Field, California
Redefine Technologies, Inc.	Supporting Organization	Industry	Golden, Colorado
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations

California	Colorado
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Steven A Wichman

Technology Areas

Primary:

- TX10 Autonomous Systems
 - ↳ TX10.2 Reasoning and Acting
 - ↳ TX10.2.7 Learning and Adapting